

Cartographers in Cubicles

How Training and Preferences of Mapmakers Interplay
with Structures and Norms in Not-for-Profit
Organizations

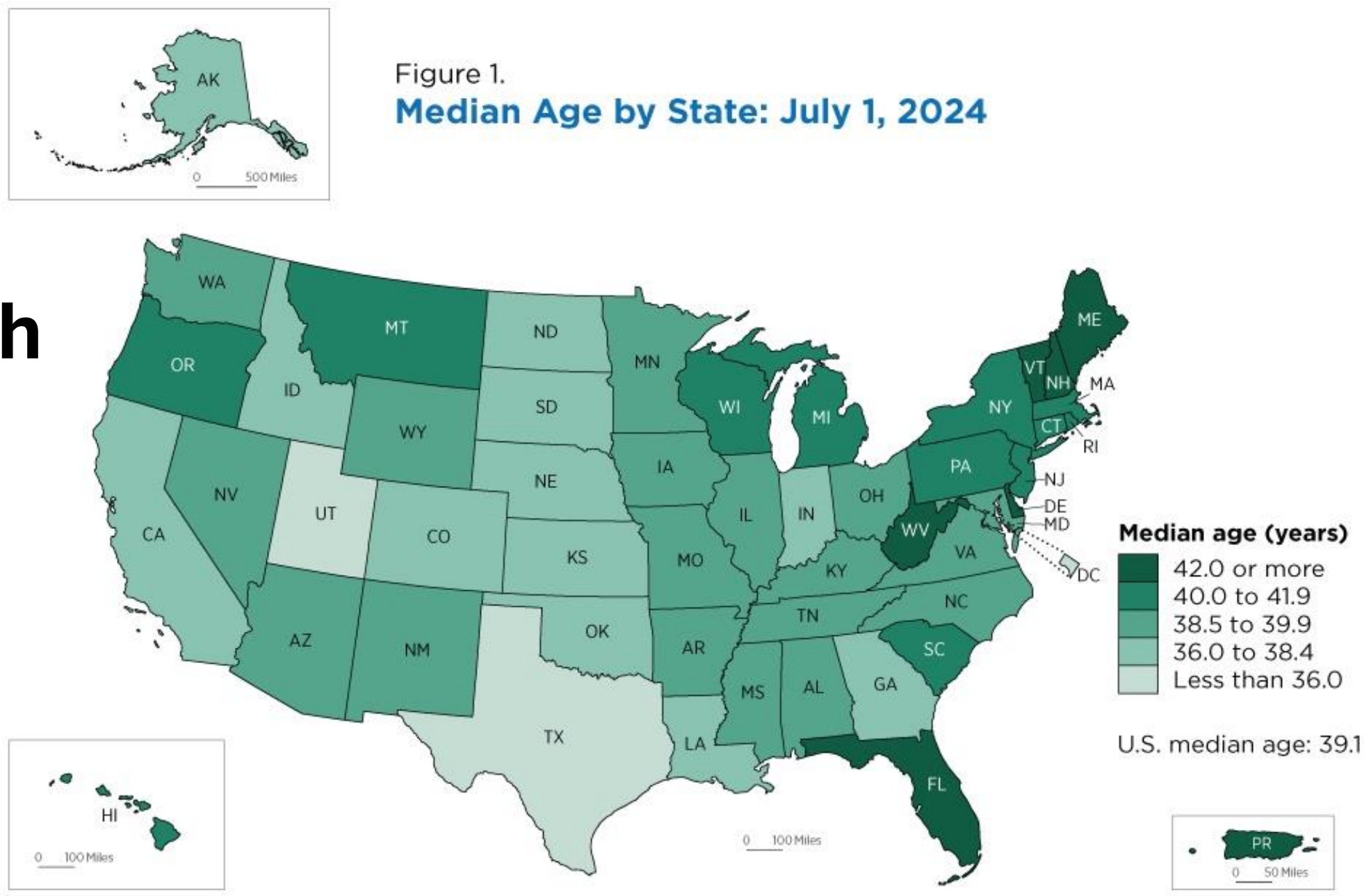
ARPIT NARECHANIA, The Hong Kong University of Science and Technology, Hong Kong SAR, China

ALEX ENDERT, Georgia Institute of Technology, USA

CLIO ANDRIS, Georgia Institute of Technology, USA

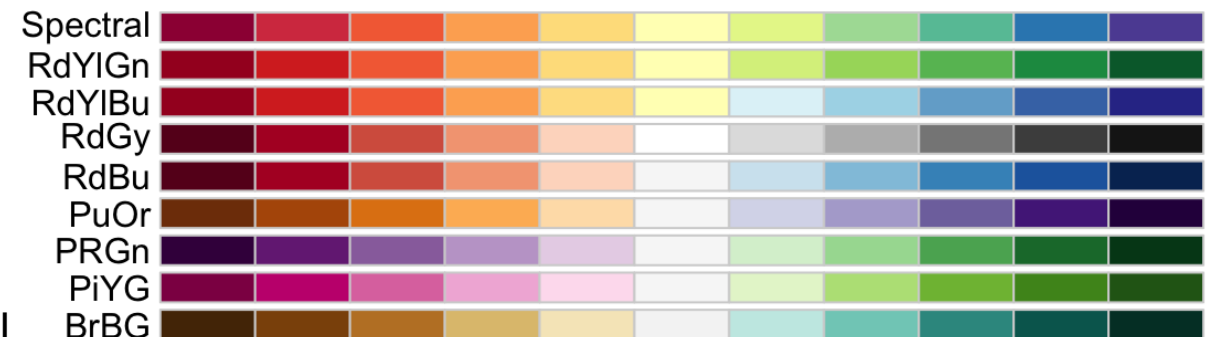
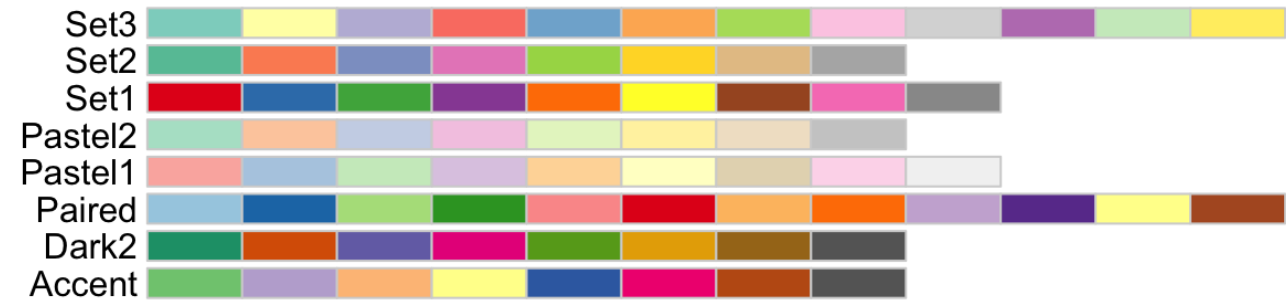
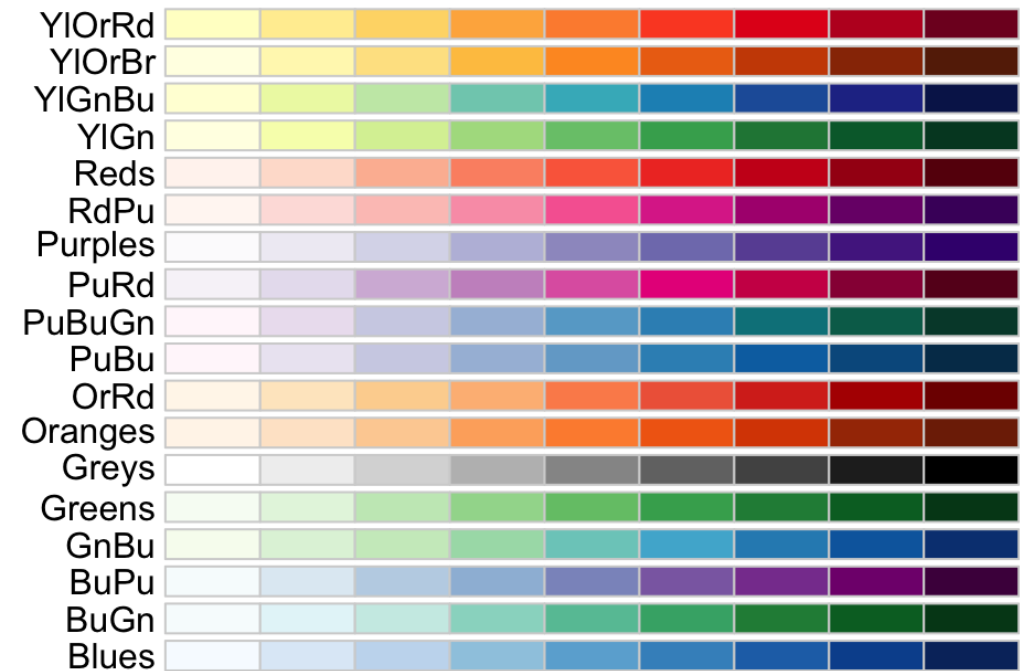
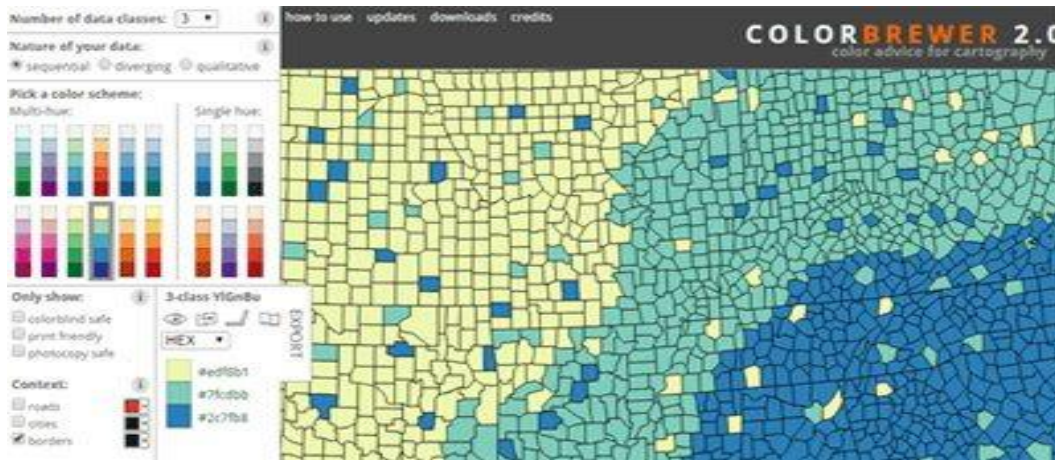
Hello,
choropleth
map!

Figure 1.
Median Age by State: July 1, 2024



Source:
<https://www.census.gov/content/dam/Census/library/stories/2025/06/young-old-counties/fig-1-young-old-counties.jpg>

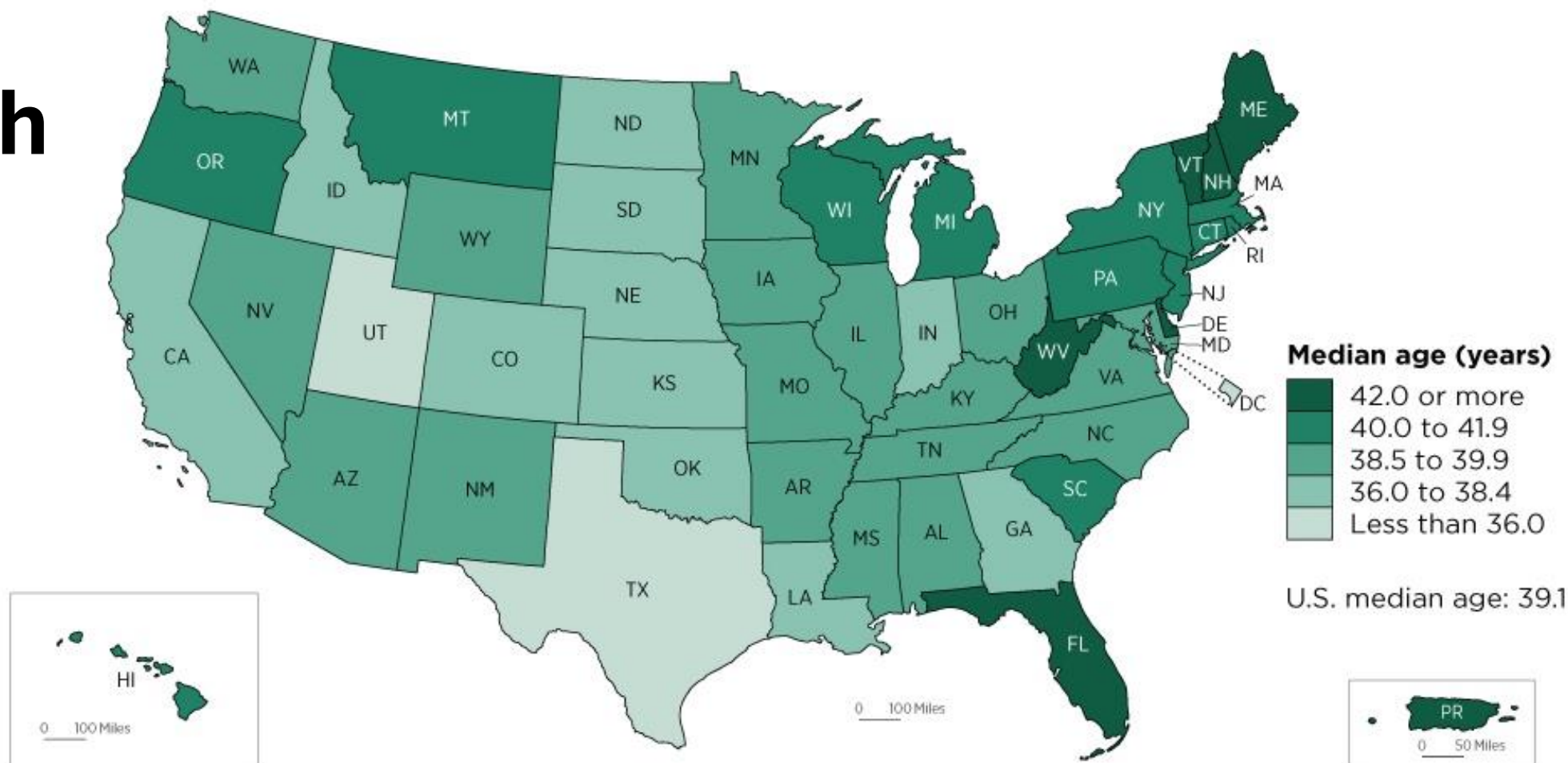
So many colors.



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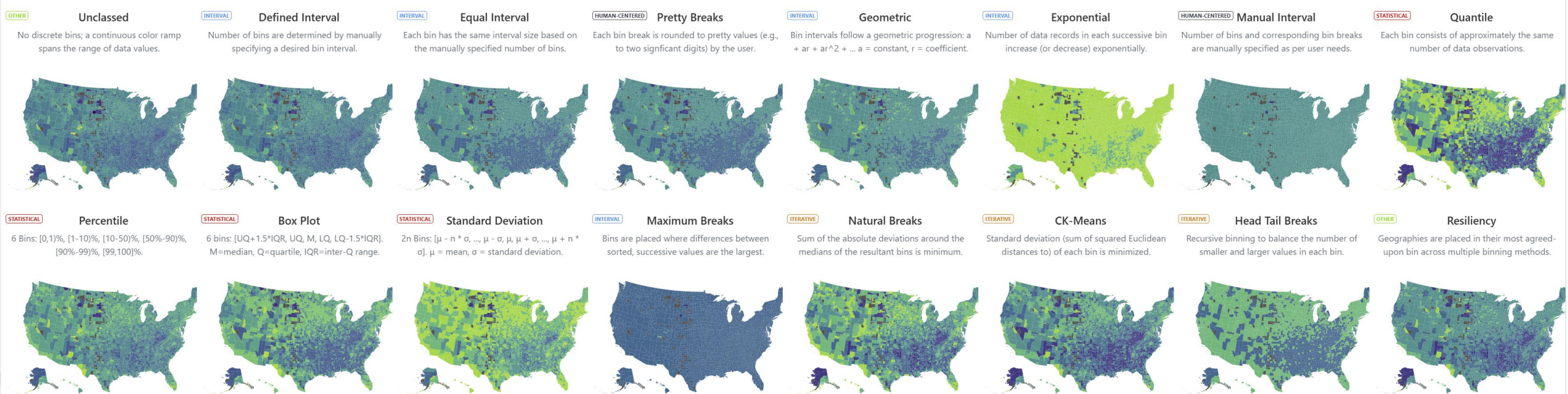
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Note: U.S. median age does not include Puerto Rico.
Source: U.S. Census Bureau, Vintage 2024 Population Estimates.

So many ways to bin data.

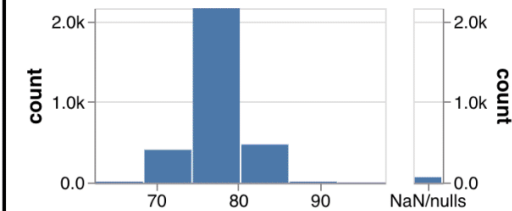


Research Overview

Data To Map

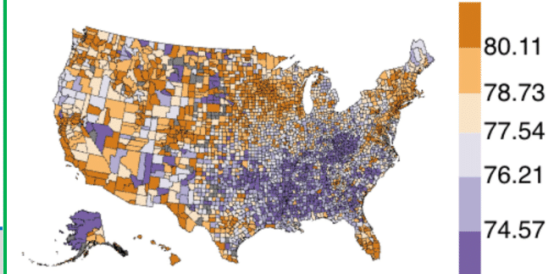
Life Expectancy (years) in U.S. Counties

3142 values; 69 (2.20%) NaN/nulls



Choices to Make during Choropleth Mapmaking

Public Map



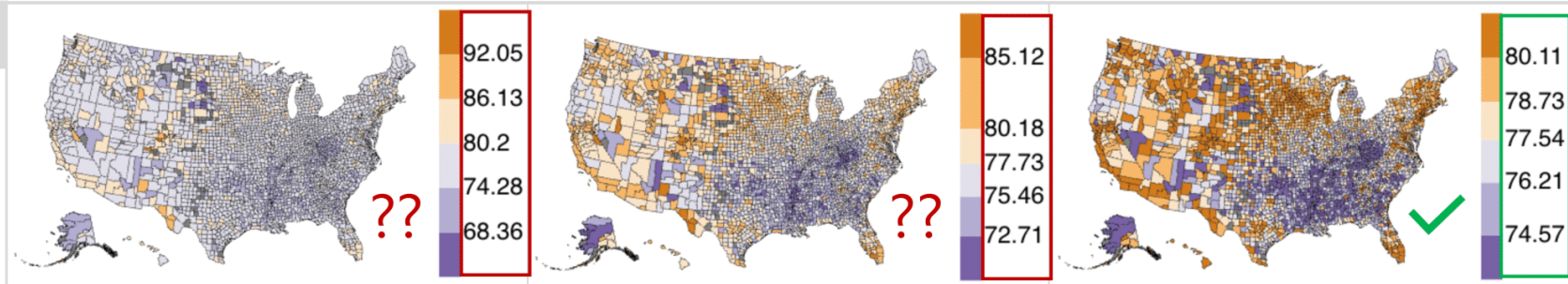
Color

Single-Hue or Multi-Hue?
Sequential or Divergent?
Discrete or Continuous?
Reds or Blues? ...



Binning Method

Box Plot? Equal Interval?
Quantile? Natural Breaks?
Standard Deviation?
Defined Interval? ...



Whom did we interview?

We interviewed **16** mapmakers from **13** globally-serving government orgs and NGOs (e.g., WHO) and federal agencies (e.g, USDA).





Whom did we interview?

We emailed them, got passed around a lot, and then we **zoomed** with them.

Participant Backgrounds

Age Ranges: 25–34 (n=4), 35–44 (7), 45–54 (4), or 55+(1)

Reported Gender: Female (6) and Male (10)

Degrees: Bachelor's (1) **Master's (13)** Doctoral (2) degrees.

Degree Fields: **Geography (9)**, public health (3), geology (2), applied geology (1), GIS-T (1), sustainable development (1), civil engineering (1), computer science (1); dual degrees (4).

Primary roles: **Creators** who created maps by themselves (10), **managers** who managed the creators (4), and **reviewers** who reviewed maps sent to them (2).

What did we ask them?

(1) How **often** do you create choropleth maps?

(2) What is a notable or **recent** choropleth map you have made?

(a) What was it about? (data) (b) Who was it for? (client) (c) Who was the audience? (end-user) (d) How was the map communicated? (media, format)

(3) Can you tell us more about your mapmaking **process**?

(a) Which **tools** do you typically use?

(b) Do you look at the data before making the map? How?

(c) How do you determine the **bins** (or classes)? What kinds of binning methods do you like to use?

(d) How do you decide the **colors**?

(e) Are there *rules of thumb* that you use?

(4) Do you tend to use the **same** mapmaking **process** every time? If not, why and what's different?

(5) Does your organization have **rules** or **protocols**, e.g., which binning methods or color schemes to (not) use?

Research Questions

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RESULTS

Notable/Recent Maps, Audience, Purpose, Formats, and Types

Topics: housing status, groundwater level, vaccine hesitancy, electricity distribution, lake bathymetry, economic factors, Medicaid recipients, gender pay gap, energy consumption, climate and environmental justice, wildlife population, poverty and nighttime lights, archaeological stupas (structures), population literacy, and population density.

Mapmaker	Experience	Role	Tools	# Bins	Binning Methods
	(1–16)	(3–33 years)	(three)	(multiple)	(custom)(twelve)
M_{10}	33	Creator	ArcGIS, ArcPro	5–10	{manual, equal} interval, natural breaks, pretty breaks
M_3	18	Creator	ArcPro, QGIS, Kotlin, In-house tool	3–6, 18	{equal, manual, geometric} interval, percentile, ck-means, natural breaks, boxplot
M_4	15	Creator	QGIS, Python, GDAL [100], CLI-based tools,	3–9	unclassified, pretty breaks, equal interval
M_5	15	Creator	ArcPro, Python, Excel, R, ColorBrewer, Inkscape [89], Online contrast checkers	5–7	unclassified, manual interval, pretty breaks
M_{15}	15	Creator	ArcGIS, ArcGIS Online, Python, QGIS, Illustrator	4, 5	standard deviation, pretty breaks, natural breaks, manual interval
M_{16}	10	Creator	ArcPro, ArcGIS Online, Excel	5	natural breaks
M_{11}	7	Creator	ArcGIS	5–7	unclassified, manual interval
M_8	6	Creator	ArcGIS, ArcMap	any	defined interval, pretty breaks
M_1	4	Creator	ArcPro, ArcGIS Online, R, SASS, ColorBrewer	5–6	standard deviation, quantile
M_{14}	3	Creator	ArcPro, R	4, 5	manual interval, quantile, pretty breaks
M_6	30	Manager	ArcPro, ArcGIS Online, QGIS, SASS, R, HighMaps [58], PowerBI [84], Tableau [112]	5–7	manual interval, pretty breaks, standard deviation, quantile
M_2	25	Manager	ArcGIS, Excel, Photoshop [5], Illustrator [4], MapInfo [109], Online color wheels	3–5	natural breaks, quantile
M_9	25	Manager	ArcGIS, ArcPro, ERDAS Imagine [57]	any	<i>“I let my team decide this.”</i>
M_{13}	6	Manager	In-house tool, MapBox, ColorBrewer	9, 11	manual interval
M_7	20	Reviewer	QGIS, Google Earth [45], ArcPro	any	{manual, equal} interval, pretty breaks
M_{12}	15	Reviewer	ArcGIS, ArcPro, QGIS, Illustrator	4–6	standard deviation, quantile, pretty breaks

Table 1. Summary statistics about our interviewee **Mapmakers’ Experience** (in number of years), their **Role** in their respective organizations, and preferred **Tools**, # **(number of) Bins**, and **Binning Methods** for making choropleth maps.

FINDING: These are the main steps for making a map

Choropleth Mapmaking Workflow and Tooling and corresponding Frequency of Use

DATA PREPARATION

DATA ANALYSIS

DATA BINNING

STYLING

POST-PROCESSING



FREQUENCY (#)



ArcPro (10), ArcGIS (7), QGIS (6), ArcGIS Online (4), R (4), Python (3), In House Tools (3), SASS (2)

Power BI, Tableau, CLI-based Tools, Google Earth, Mapbox, MapInfo, HighMaps, Kotlin, GDAL, ArcMap (1)

Microsoft Excel (3), ERDAS Imagine (1)

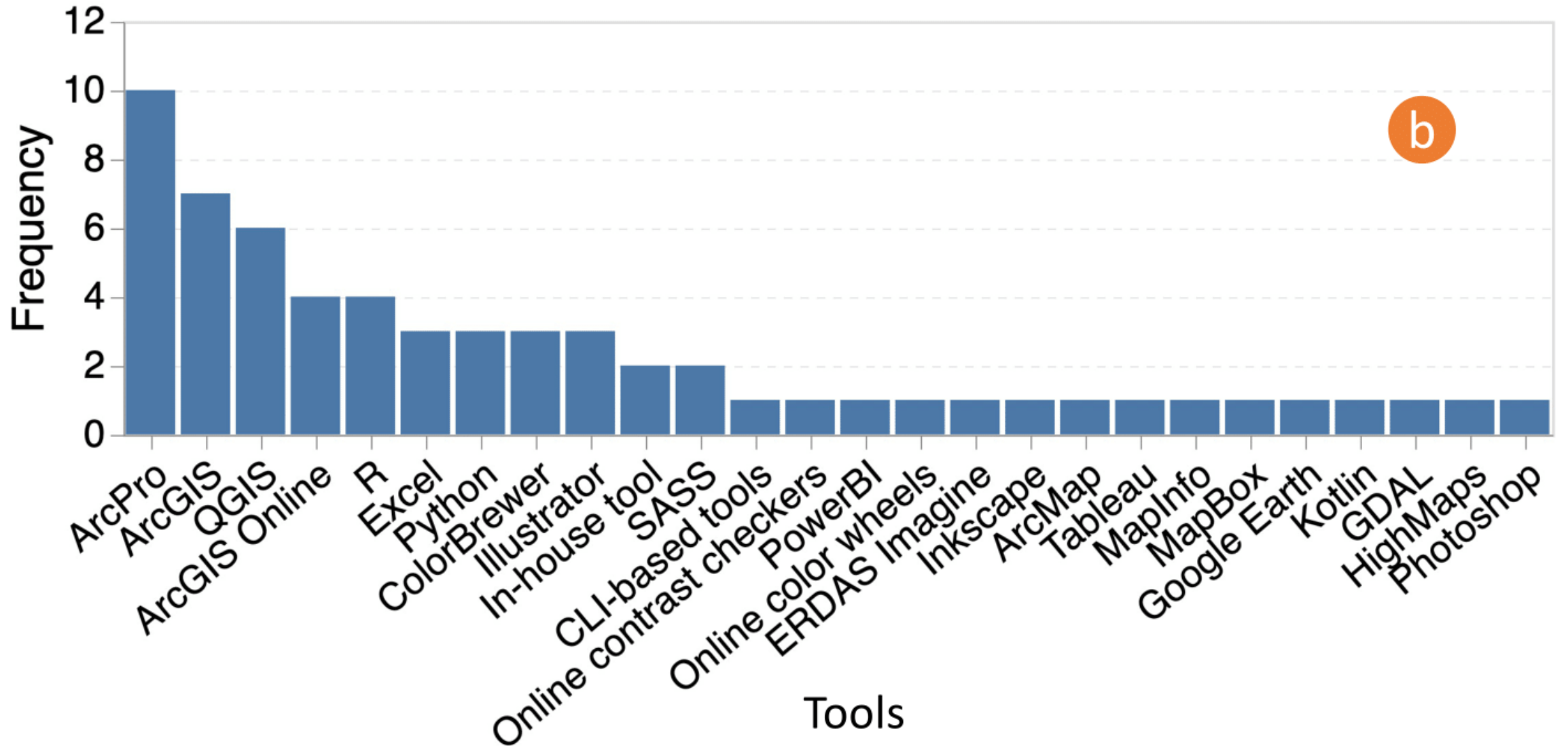
Online Color Wheels, Contrast Checkers (1)

ColorBrewer (3)

Illustrator (2)

Photoshop, Inkscape (1)

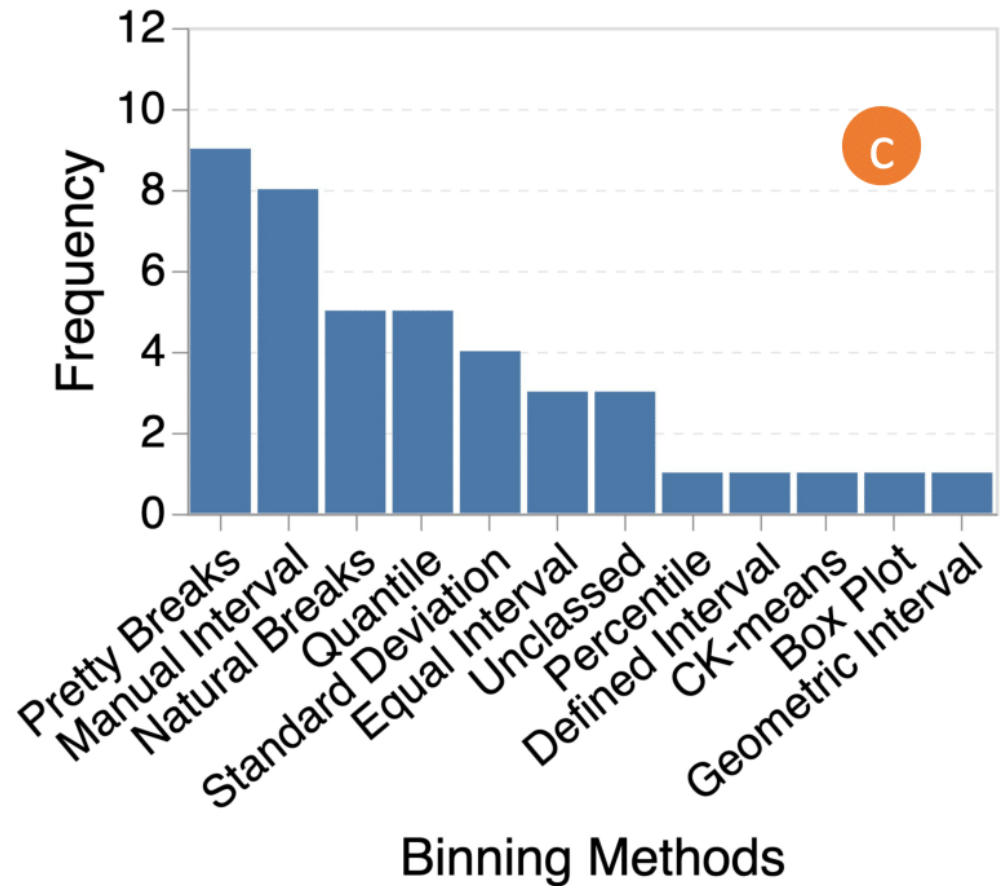
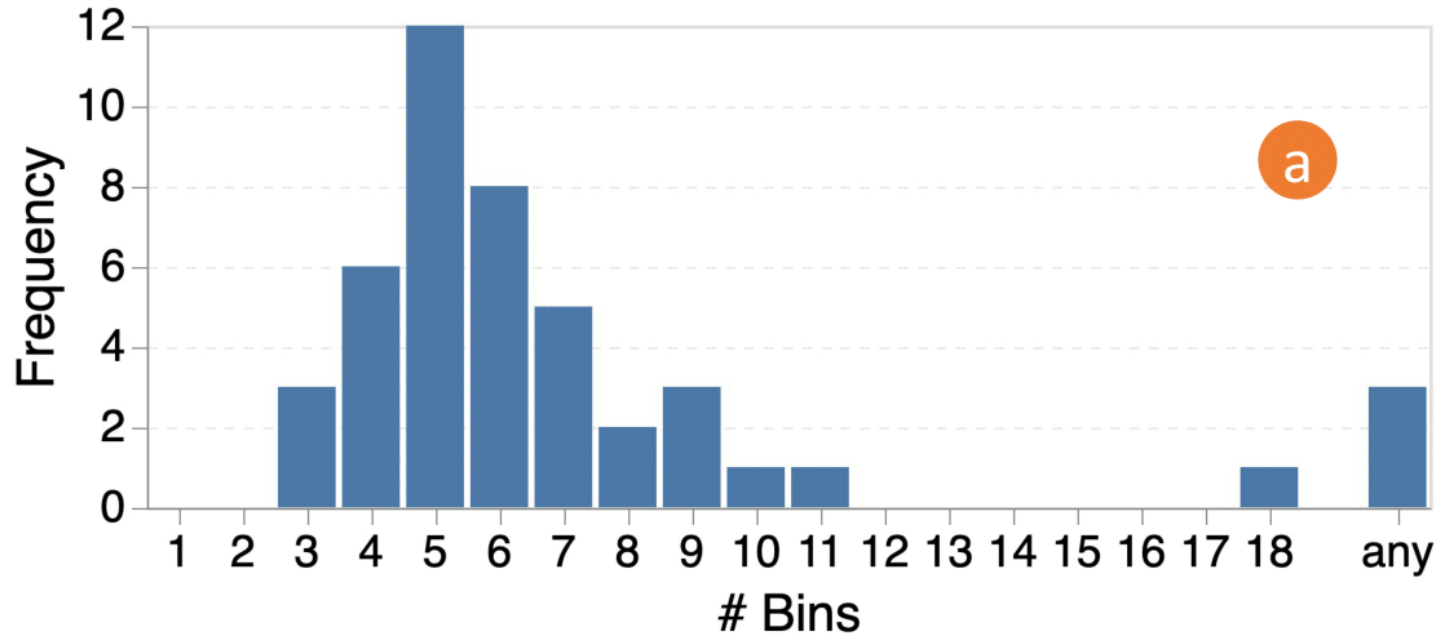
A closer look at software



The choice between software was a result of the organization's size, available resources, and nature of work.

Let's answer some more RQs on color and binning...

What about data bins?



Yes, this is a very specific piece of knowledge.

How do you choose these divisions?

- Personal preferences (“I just use the ArcGIS default, natural breaks”–*M16*)
- Organizational policies (“it is a practice to use standard deviation here”–*M1*)
- Prior choices (“if there is a report that goes out every year, we also re-use the binning method every year, irrespective of the new data distribution”–*M6*)
- Data (“equal interval is used for soft-range data, geometric interval or manual interval is used for long-range data”–*M3*).

HOW DO YOU CHOOSE COLORS?

- Personal preferences (*M10,16*)
- Collaborative brainstorming with their teams (*M1*)
- Data-driven considerations around semantics (*M11*) and type (*M5*)
- Target audience literacies (*M3,8,12*)
- Socio-economic and political connotations (*M1,13*)
- Accessibility requirements colorblind (*M1,2,4–7,12–16*) and print (*M3,5,16*) friendly colors
- Prior similar work (*M1,7*)
- Client requirements (*M15*)
- Branding requirements (*M1,4–6,12,16*)

COLOR: BEST PRACTICES

- *M1* never uses red to connote racial groups
- *M13* avoid reds and blues due to their political implications in the U.S.
- *M14* often chose pink “for binary data as it doesn’t have many semantic associations.”

What about their general approach to mapping?

NOT NOW, MAP!

M5 said their process often depends on their mood and how they're feeling on the day, e.g., **“some days [I will] want to be super logical and organized, document everything, try and back-up all choices; and some other days [I] just want to get this map ‘out of the door’.”**

CUSTOMER RELATIONS

M15: A client asked them to “**change [certain bin extents] so that [certain] districts show as bright red, so that people think there’s the problem, which defeats the purpose of making an unbiased map.**”

M15: sometimes having to “**fight with [the client], but most of the time the client [gave in to the mapmaker’s expertise].**”

And protocols?

PROTOCOLS WERE COMMON

- All organizations except *O3* reported having some kinds of mapmaking protocols, guidelines, and/or policies that are enforced for all public facing maps used for presentation, publication, or sale.
- *O2,4,6,7,8,11,13* had well-defined rules and style guides on colors, symbology, typography, and/or other essential map elements such as the date, credit(s), disclaimer(s), data source(s), and/or legend.

PROTOCOLS IN CONFLICT

M8's organization had guidelines on colors and provisions for creative freedom; *M8* tried “to mix things up a little bit, e.g., by not using the same red or gray for roads or the same shade of blue for water.”

M6's organization was stricter and they “must explain [to the review team] why [they] tweaked colors. It [was] kind of annoying to be limited but it makes sense in the long run.”

M16 was not content with the fonts: “some of [them] are not readily available and require a paid subscription. 90% of [their] staff doesn't have it so it's kind of useless.”

M4: “There are no style guides and that's something I'm annoyed about.”

Discussion & Conclusion

DISCUSSION: ODDS AND ENDS

- **Territorial disputes and geopolitical tensions** restrict them from depicting certain boundaries or presenting data in potentially controversial ways
- **No audience feedback mechanisms**
- **Lively conversations.** No one gave short, concise answers to these questions, nor did they query why we were interested in these subjects

CONCLUSION

- We interviewed 16 mapmakers from 13 government organizations, NGOs, and federal agencies.
- Our goal was to learn about how trained cartographers work within the provisions and structures of organizations.
- Classic limitations of sample size and US/India.
- CSCW and HCI researchers and cartographers can learn more about the territory between standards and practical graphic production in the future.